

Claims 1-11 are rejected under 35 U.S.C. §112, second paragraph as being indefinite. The Examiner requests that applicants insert paragraph markers to make it clear what steps are contemplated.

Applicants have complied with the Examiner's request.

Claim 11 is rejected under 35 U.S.C. §101 as being directed to non-statutory subject matter. This claim has been canceled, therefore this rejection is now moot.

Applicants have added a new claim 12 which claims a plant which is produced by the method of the invention. Applicants submit that this new claim is fully compliant with 35 U.S.C. §101.

Claim 11 is rejected under 35 U.S.C. §102(b) as being anticipated by Brooks et al. (Vegetation 1981).

Since this claim has been canceled, this rejection is now moot.

Claims 1-11 are rejected under 35 U.S.C. §103(a) as being unpatentable over Raskin et al. (U.S. Patent No. 5,787,735) in view of Brooks et al. (Vegetation 1981).

Raskin is relied upon as teaching a method of removing metals including nickel from metal-contaminated soil by growing a metal hyperaccumulating plant (including the genera *Alyssum*) on the soil. The Office Action indicates that the soil is maintained at a pH of 5.8 - 6.2, and that metal chelating agents and ammonium-containing fertilizer are added, to produce plants having an increased lead, nickel, chromium, cadmium and zinc accumulation.

The Examiner admits that Raskin does not teach the specific soil conditions required for nickel accumulation by the *Alyssum* plants. The Examiner relies on Brooks to make up for this discrepancy. Brooks is relied upon as teaching three *Alyssum serpyllifolium* subspecies whose nickel hyperaccumulation varies at varying concentration levels of calcium and magnesium, confirming a significant association between low calcium/magnesium ratio and nickel uptake in these subspecies. The Examiner takes the position that it would have been obvious to one with ordinary skill in the art at the time the invention was made to utilize the method of phytorecovering heavy metals from soils taught by Raskin, and to modify that method by incorporating the specific soil conditions taught by Brooks. The Examiner takes the position that the choice of specific *Alyssum* species or specific chelating agents would have been a routine optimization of process parameters.

Applicants note that the cited Raskin '735 patent is a Continuation-In-Part of the application which matured into U.S. Patent No. 5,364,451. The '451 patent is discussed in the present specification. Applicants have the following additional comments on the '735 patent.

The '735 patent is directed to a method of removing metals from a metal-containing soil environment using plants of the family Brassicaceae, which includes *Alyssum* species. According to the method, a screening system is used to identify terrestrial plant species with the highest metal accumulating potential, and the seeds

of these plants are then subjected to EMS mutagenesis. The seeds are then planted in soil which has been tilled to a depth greater than about 15 centimeters. Chelating agents are added to the soil in an amount sufficient to form a soluble or insoluble complex with the metals in the soil. Further treatments designed to increase the mobility of the metals into the plants include decreasing the soil pH (preferably to about 4.5 to 5.5) adding ammonium phosphate fertilizer, and/or using electrical fields. See columns 7-8. The metals accumulate in the roots and may be translocated from the roots into the shoots (i.e., the above-ground portions of the plant).

Raskin says absolutely nothing about the concentration of calcium in the soil, nor the ratio of calcium to magnesium in the soil.

Brooks tested the nickel uptake of three species of *Alyssum*, with varying concentrations of nickel, calcium and magnesium. Figure 4 on page 187 summarizes the results. Graph B shows that nickel uptake in the presence of a constant level of calcium is inhibited at lower nickel levels. This finding is in line with those findings disclosed on page 3 of the present specification (i.e., reports of a negative correlation between calcium concentration and nickel uptake). To further this hypothesis, Graph D shows that calcium uptake is inhibited in the presence of a constant amount of nickel at lower levels. From these results, it seems that a plant would either uptake nickel or calcium, but not both. If a high uptake of nickel was desired, therefore, Brooks teaches that the calcium level should be as low as possible. This finding is also in line with

those of the prior art, as discussed in the sentence bridging pages 3 and 4 of the specification.

Thus, one of ordinary skill in the art having the Brooks reference before him would want to keep the calcium levels as low as possible in order to recover a higher amount of nickel in the soil. Since the present claims actually require an increased amount of calcium from the very low levels disclosed in the prior art, Brooks actually teaches away from the present invention.

Turning to the calcium/magnesium ratio, Graph F of Brooks show that the magnesium uptake is increased in the presence of nickel. Thus, if the three components (i.e., nickel, calcium and magnesium) are in the soil, Brooks seem to indicate that magnesium uptake would increase, while calcium and nickel uptake would be depressed. Brooks recognizes that the infertility of serpentinic soils would be compounded in such a situation. See the last paragraph of page 187.

Thus, Brooks seems to indicate that the calcium/magnesium ratio should be very low if nickel uptake is to be increased. This also teaches away from the present invention, which claims a relatively higher ratio of calcium/magnesium than is accepted in the art.

To summarize, applicants submit that Brooks teaches away from the increased calcium concentration levels and calcium/magnesium ratios claimed in the present case. Thus, the combination of Brooks and Raskin would not result in the present invention.

Applicants respectfully submit that this rejection should be withdrawn.

Claims 1-11 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chaney et al. (U.S. Patent No. 5,711,784). The Examiner relies on Chaney as disclosing a method for recovering nickel from soil by growing an *Alyssum* species in soil maintained at a pH of 4.5 to 6.2 and having an exchangeable calcium concentration at 20% lower than the exchangeable magnesium concentration. The Examiner also notes that ammonium-containing fertilizer and chelating agents can be added.

Applicants respectfully submit that the '784 patent could not render the present invention obvious. The '784 patent does not mention the specific soil conditions necessary in the present invention to achieve the desired results, such as maintaining the calcium concentration from about 0.128 mM to about 5 mM, and a pH of below about 7.0. Since these particular attributes of the present invention are not disclosed or suggested in the '784 patent, this reference could not anticipate or render obvious the present invention.

Applicants note that the Examiner has made two double patenting rejections over the '784 patent, and additional U.S. Patent No. 5,944,872. Applicants respectfully submit that these rejections should be held in abeyance pending the resolution of the other outstanding issues.

In the event this paper is not timely filed, applicants hereby petition for an appropriate extension of time. The fee for this extension may be charged to our

Deposit Account No. 01-2300, along with any other additional fees which may be required with respect to this paper.

Respectfully submitted,  
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**Atty. Docket No. P108172-09005**

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